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UNITED STATES
DEPARTMENT OF AGRICULTURE

DEPARTMENT CIRCULAR 297

Washington, D. C. October, 1923

THE EELWORM DISEASE; A MENACE TO ALFALFA IN AMERICA.

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CONTENTS.

	Page.
The dangerous character of the parasite	1
Description of the alfalfa eelworm disease	2
Season of appearance	4
Cause of the disease	5
Manner of spread	5
Means of control	7
The disease a possible menace to other crops	8

THE DANGEROUS CHARACTER OF THE PARASITE.

THE ALFALFA STEM NEMATODE, a parasitic eelworm, which causes the disease herein described, has been under observation in a few isolated locations in America for the last two years. It is proving itself to be an extremely dangerous pest and one that deserves prompt and aggressive measures to check it before it becomes more widespread. It is feared that its present distribution may be greater than is now known. This circular is designed to inform the public of the nature of the disease and to enlist aid in determining definitely its presence or absence in all alfalfa-growing sections.

The alfalfa eelworm disease is responsible for serious loss where it occurs elsewhere in the world. In South Africa, especially, it is almost universally distributed. Wherever found, it shortens the life of the alfalfa crop by several years. In America it has not been under observation long enough to permit its full capabilities of doing damage to become known. Where it has been observed, however, it is serious enough to cause general alarm. In one section a field only 3 years old was almost completely destroyed by this disease. In another

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section portions of fields of various ages were reduced to a distinctly unprofitable condition within a year or two, and in addition the disease has spread alarmingly from original points of infestation.

DESCRIPTION OF THE ALFALFA EELWORM DISEASE.

The disease is manifested by a thinning out of the alfalfa in spots in the field, due to the dying of some of the plants. This leaves a poor stand of dwarfed plants, with a reduced number of stems, some of which may be more or less yellowed and distorted. In an early stage of the disease a wilting of some of the stems may be the sign by which the presence of the parasite may be recognized. A close examination of affected plants shows that the disease is localized in the crown of the plant. Stems are swollen at the base and brown in color. They are often brittle and easily broken off; in fact, this brittleness is one of the means of easy diagnosis. New buds and sprouts arising in the crown may be swollen, pale yellowish or cream colored, and of a spongy texture. Rapidly growing, succulent shoots that are affected are often swollen at their tips, or they may have swollen side shoots, thus carrying the disease from a few inches to a foot or more above ground.

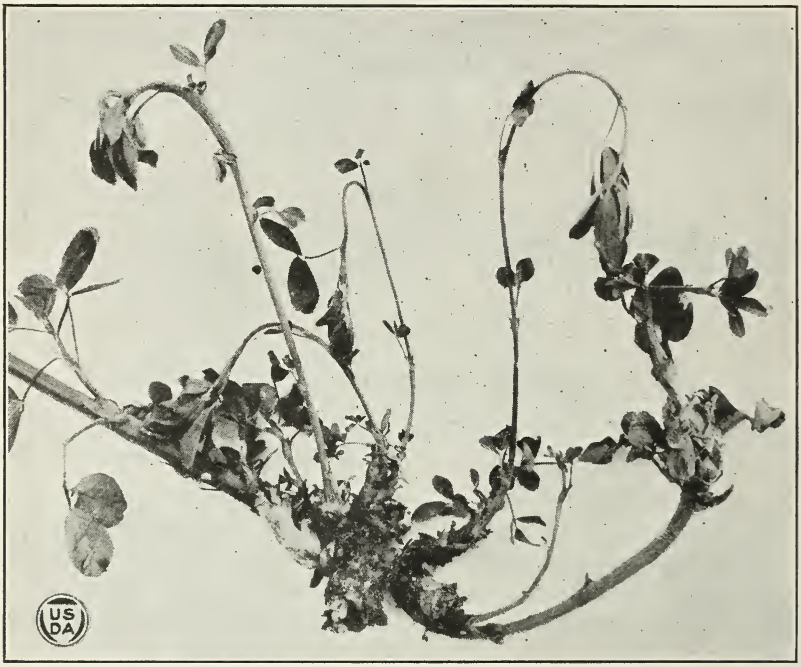

FIG. 1.—A portion of the crown of an alfalfa plant affected with the eelworm disease. Note the swollen sprouts and stem bases and (to the right) the swollen tip of a growing stem. Such swollen parts contain hundreds of living eelworms.

The accompanying reproductions from photographs illustrate typical cases of the disease. Figure 1 shows to best advantage the swollen stem bases and new sprouts and also (at the right) a swollen tip which may grow several inches above ground if the injury is not too great at the base. Figure 2 shows the swollen bases of older stems which have developed in spite of the presence of the parasite in great abundance in the swollen parts. Diseased young shoots are

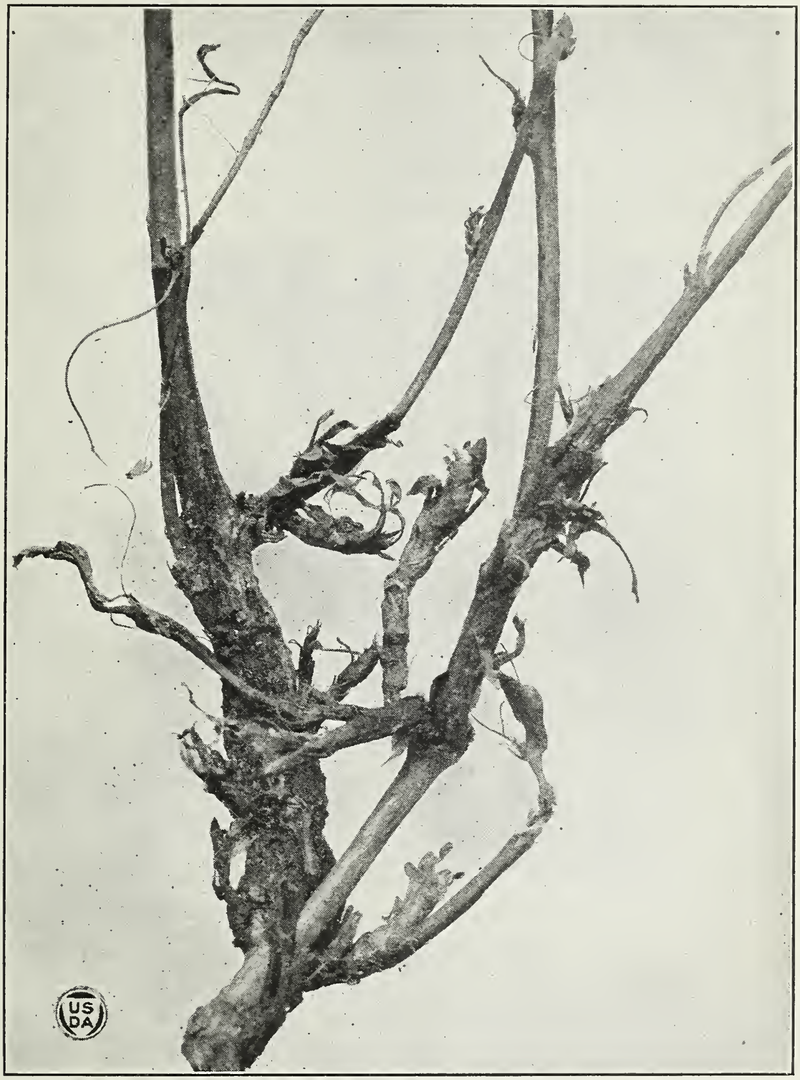

FIG. 2.—A portion of an alfalfa plant affected with the eelworm disease. The stems are much swollen and rough where affected and are dark brown in color. New sprouts have started, but these are also severely infested with nematodes, as is shown by their swollen condition. One of them, almost completely decayed at the base in typical fashion and partly broken, extends across the center of the picture.

shown as well. A normal stem is smooth and slender to its very base, as is shown in Figure 3.

When examining a "sick spot" in a field for the possible presence of the disease, one should take into consideration more than one of the symptoms listed. A thin spot may be caused by a variety of conditions, such as (1) a poor initial stand, (2) too little or too much water, (3) the presence of alkali in the soil, (4) a deep cut when the ground was graded, or (5) some other disease, such as Sclerotinia wilt. The surest symptoms by which the eelworm disease may be recognized are the swollen buds and sprouts and the enlarged browned stems already mentioned. When once the disease is seen, the striking contrast between an affected stem and a healthy one is very evident.

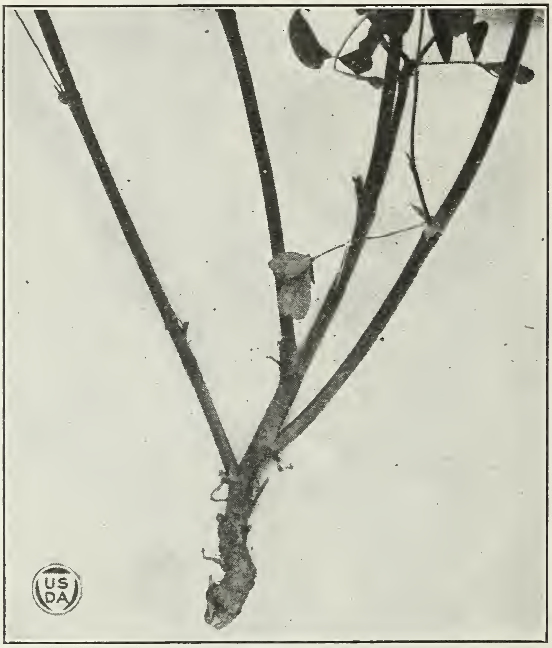

FIG. 3.—A normal alfalfa stem, with side branches smooth and slender throughout.

Badly diseased plants show a distinct rotting of the stem bases and crown, with some or all of the stems completely killed. The rot in such plants extends into the roots, hence the names "stem-rot" and "root-rot" which are sometimes applied to the disease, though there are other rots distinct in origin which affect the stems and roots of alfalfa. Plants in such condition rarely survive the winter.

SEASON OF APPEARANCE.

The spring of the year is the best time to look for the disease. The symptoms described are more prominent before the first cutting than after it. The typical symptoms can be recognized at any time, however, though in mild cases, the occasional affected plants may be completely covered up by the vigorous growth of surrounding healthy plants. A favorable time for a survey is the period of two or three weeks after the new growth has obtained a good start, following a cutting. Diseased plants can then be easily recognized by their generally weakened condition and off color. Much of the spread of the disease appears to take place in the fall, winter, and early spring. Diseased fields, therefore, are invariably in much worse condition in the spring than they were the season before.

CAUSE OF THE DISEASE.

The organism that causes the disease is an eelworm or nematode, technically known as *Tylenchus dipsaci*, a small roundworm, scarcely one-twentieth of an inch long when fully grown. It multiplies by means of eggs, as many as 200 being laid by a single individual. The newly hatched young, or larvæ, are the same shape as the adults but only about one-tenth as large. Under moist conditions these larvæ migrate or are carried by irrigation water or other means to new plants. Penetrating the plant through tender succulent parts, they grow to maturity within the plant tissues. Their presence there acts as a stimulation which causes the swellings and abnormal development, and their parasitic action robs the plant of its power to produce a strong growth. A single swollen stem or sprout, such as that attached to the left of the crown in Figure 1 may contain hundreds of eelworms, each deriving its food from the plant. Finally the nematodes become so abundant as to completely kill the plant. They then leave it and migrate into the soil, ready to attack other plants which they may be able to reach.

This eelworm is distinctly different from the one which causes root-knot in a wide variety of plants and abnormal swellings on potatoes and other tuberous crops. The alfalfa eelworm occurs only in the aerial parts of the plants.

MANNER OF SPREAD.

The organisms may be carried long distances by irrigation water or by hay. Waste water from infested fields carries the organisms by the millions. It may empty into a ditch that does duty lower down on the same farm or on an adjacent farm, or it may go back into a large lateral ditch or even a river, and thus be carried to another irrigation project miles away. In hay the organisms show their remarkable resistance to drying. Figure 4 shows several stems of alfalfa hay, cured under normal conditions, with typical eelworm swellings. These specimen stems were photographed five months after they were cut. Living nematodes were recovered from them,

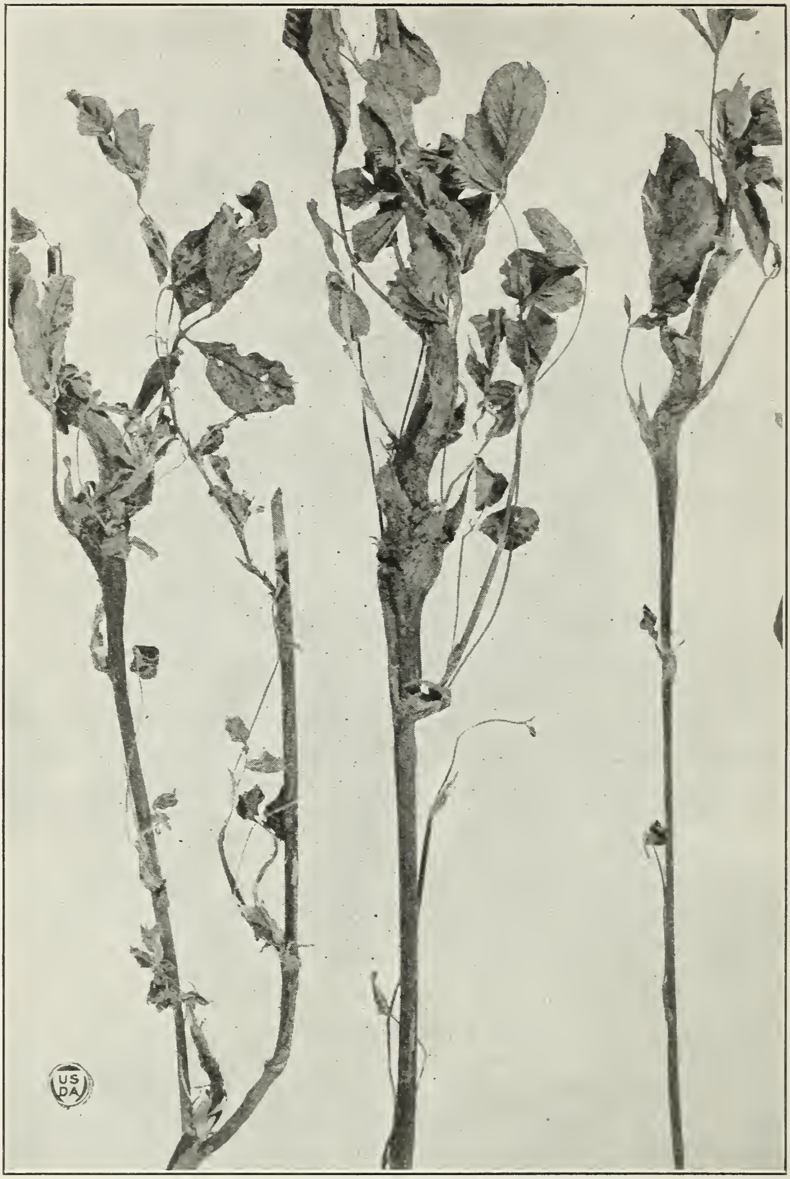

Fig. 4.—Small stems of alfalfa hay cured normally and photographed five months after being cut from diseased plants. The swellings contain numerous nematodes which lie coiled up in a dormant condition within the tissues of the plant. Moisture is all that is needed to revive them. Small bits of the affected stems may be blown by the wind or carried in manure or by other means to new fields and thus start new infections. Not alfalfa alone but other crops as well are subject to infection.

and when used to inoculate alfalfa plants in the greenhouse they produced the typical disease. Infested hay, therefore, is an important carrier of the disease.

The spread over shorter distances may be accomplished by farm implements, which probably play a great part in carrying infection to all parts of a farm from small centers of infection, or by animals, birds, man, or wind, any one of which may carry a bit of soil or mud or bits of diseased plants containing many eelworms or their eggs.

MEANS OF CONTROL.

In this case an ounce of prevention is worth a ton of cure. It is worth any effort to prevent the first infection from occurring. Avoiding the various means of spread mentioned above is one way to do this. Some of the means, such as transmission by wind or birds, can not be controlled. The safest way, especially from the point of view of the owners of the millions of acres that are free from the disease, is to eradicate the disease wherever it occurs. This will involve plowing up the affected fields and devoting them to other crops for at least three years. This gives sufficient time to starve the organisms completely. The removal of alfalfa must be complete, however; otherwise enough of the organisms will be held over alive to bring about new centers of infection when alfalfa is again planted. Not only must all volunteer alfalfa plants appearing in the field after the plowing be grubbed out, but those on the ditch banks and fence rows must be destroyed as well.

After doing the work of eradication of alfalfa in an affected field, all tools and implements should be thoroughly cleaned and disinfected. Hot water or a direct flaming with a torch of some kind, momentarily applied, is the surest way to kill any nematodes or their eggs that may be sticking to the implements. If this is done, the tools may be used anywhere without fear of carrying the disease. It must be kept in mind that fields that had diseased alfalfa contain the living organisms in the soil. Consequently, spread from such fields by implements or use of waste water must be guarded against for two years or more.

It is recognized that difficulties are involved in putting these suggestions into practice. They can, however, be carried out, and these are the only methods which are now regarded as effective. Further investigations of methods of eradication are needed and are in progress. The direct sterilization of the soil by the application of chemicals or heat may be practicable in very limited infestations, but experience gained in work on the potato wart indicates that such treatment is highly expensive and of doubtful efficacy when applied to large areas.

THE DISEASE A POSSIBLE MENACE TO OTHER CROPS.

A further reason for prompt and aggressive action in dealing with this disease is the fact that the causal organism may under favorable conditions pass over to and affect other crops. In a small experimental way, red, white, and alsike clovers, buckwheat, rye, English pea, turnip, and even potatoes have been attacked and definitely injured by the alfalfa eelworm. Some weeds are also subject to infection. The entire list of possible hosts has not yet been ascertained in America. From the results already secured, however, the alfalfa eelworm disease, aside from its seriousness on that crop alone, appears to be a menace to agriculture which should be met promptly by strenuous measures. An attempt should be made to spot all infestations and to at once eradicate the disease, a thing which is very possible of accomplishment unless it is already too generally established. If this is done, the immense losses due to reduced yields and to the need for more frequent plowing up and replanting, such as occur in South Africa, may be avoided.

It is requested that specimens of suspected material be sent in promptly to the Bureau of Plant Industry, United States Department of Agriculture, at Washington, for identification, together with an account of the extent to which the disease occurs.

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